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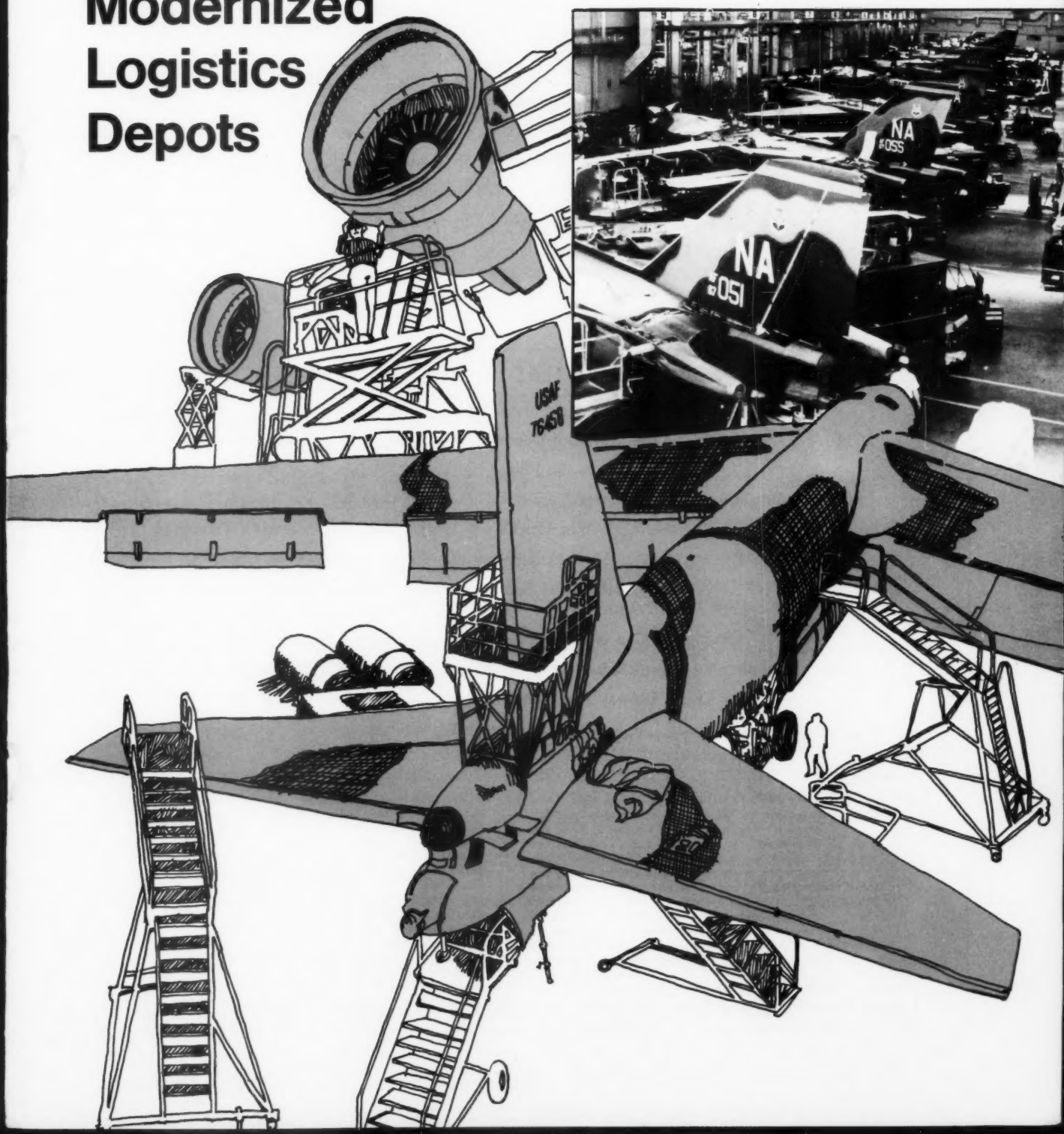
AIR FORCE Civil Engineer

Modernized Logistics Depots



AIR FORCE
Civil Engineer

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The AIR FORCE CIVIL ENGINEER is an official nondirective Headquarters US Air Force publication published quarterly under provisions of Chapter 2, AFM 5-1. Its purpose is to provide Air Force Civil Engineers with a timely and comprehensive picture of the importance, wide ranging involvement and direct relationship of civil engineering activities to successful accomplishment of the Air Force mission. It provides current information about significant civil engineering programs and accomplishments throughout the Air Force; pertinent developments in science engineering and management; and educational/training opportunities for enhancing professional thought and development. The Journal is edited and published by the Civil Engineering School, Air Force Institute of Technology. Contributions, suggestions and criticism are welcome. Opinions expressed do not necessarily reflect the official viewpoint of the Department of the Air Force, the Director of Civil Engineering or the editorial staff. DISTRIBUTION: F. The Journal's annual subscription prices are: $2.00 domestic; $2.50 foreign; 45 cents per copy. Mail check or money order to Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

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Current Emphasis

Information published here is designed to keep civil engineering personnel aware of late developments and significant trends within the career field.

ENERGY CONSERVATION PROGRAM--As a result of a Presidential Memorandum the Air Force has been tasked by OSD to consume 7 percent less energy in FY 74 than used in FY 73. An Air Force reporting system has been established to monitor the program and obtain the actual reduction realized.

AFM 86-1 PUBLISHED--Guidance on "Total Programming" has been omitted from the recently published AFM 86-1; revised guidance will be issued shortly in AFM 85-1.

POLLUTION DISCHARGE EMISSION SYSTEM--The National Pollution Discharge Emission System replaces the wastewater discharge permit program initiated under the 1899 Refuse Act. All Air Force bases are required to file applications for permits (short form only) with the appropriate regional office of the Federal Environmental Protection Agency. (See AF/PREV letter 20 March 1973.)

SELF-CONTAINED BREATHING APPARATUS--General Services Administration has discontinued procurement of stainless steel air tanks. All future breathing apparatus ordered utilizing TA 490 will have the new lightweight aluminum tank.

DESIGN AND CONSTRUCTION STATUS REPORTING--Internal procedures for processing Construction Status Report, RCS: AF/PRE (AR) 7124, formerly HAF-Z44, have been revised. Concurrently, AF Form 1959 was revised to make it compatible with standard computer printouts and to aid in standardizing the report. Instructions have been distributed to the field in draft and will be incorporated in AFM 89-1 later this year. Forms should soon be available through normal distribution channels.

UTILITIES CONSERVATION PROGRAM--With the ever increasing demand for energy reduction and available dollar resources, it is incumbent on all Air Force installations to give greater emphasis to the Utilities Conservation Program. AFM 91-12 outlines specific items that can result in meaningful cost reductions. Also, more stringent requirements can be expected as the fuel shortage continues.

PROJECT VOLUNTEER RELOCATABLE CLASSROOMS--Follow new AFR 86-11 for projects to place Project Volunteer relocatable classrooms. About 200 of these classrooms for off-duty airmen education are being equitably distributed among major air commands.

FIRE PROTECTION OPERATIONAL PROCEDURES--Revised AFM 92-1 is in final draft and coordination is underway. Publication is scheduled for January 1974. Should any significant delays arise, major air commands will be advised accordingly.

RECYCLING OF CORRUGATED BOXES--The paper industry indicates that demand for used corrugated boxes is at an all-time high and will continue to increase. BCEs are encouraged to contact local paper stock dealers or mills to develop a recycling program which will reduce refuse handling costs.

FIRE COURSE IDENTIFIER CHANGED--Air Training Command recently changed the course identifier for the Firefighter Rescueman Course from 2ASR57150-3 to 3AZR57150-3. This changes the course from special training to permanent residence training. This course provides the training needed to cope with all types of emergency situations. Personnel assigned to base Rescue Teams should be scheduled for attendance at the earliest opportunity.

SEDIMENTATION CONTROL--There is increasing interest among states in sedimentation control legislation. As of July 1973, Iowa, Maryland, Michigan, North Carolina, Ohio, Pennsylvania, South Carolina and Virginia have enacted some form of control laws. Georgia, Illinois, Minnesota, Montana, New Jersey, New York, Oregon, West Virginia and Wisconsin have introduced such legislation. Installations should keep informed of local standards.

REVISED AFM 89-1--By the end of the year, revised AFM 89-1 should be issued. It provides the information and broad guidance relative to policies and procedures for Air Force design and construction. The new manual will consolidate and update 10 Air Force publications--AFM 89-1, AFP 88-2, AFR 88-9, AFR 85-17, AFR 88-7, AFR 88-6, AFR 89-6, AFR 88-10, AFR 89-11 and AFM 88-29.

P-341 PROVIDES NEEDED FACILITIES--The recently authorized use of P-341 funds for fast amortizing projects (within three years) has provided needed facilities to several commands.

PROFESSIONAL MILITARY EDUCATION--PME courses provide meaningful continuing education which tends to enhance career performance, progression and potential. If not selected to attend in residence, officers are encouraged to complete the courses through the ECI or seminar programs. Completion by ECI/seminar does not preclude in residence attendance at a later date. See your local Education Officer or call PALACE BLUEPRINT for details.

MOTOR VEHICLE REPLACEMENT CODING--TO 00-25-249 provides a system whereby motor vehicles are coded for replacement. If civil engineer requirements are to compete under current austere funding conditions, it is imperative that these codes be correct to support the Buy and Budget program. Replacement coding is vital to the user; therefore, each BCE vehicle control officer should familiarize himself with the coding system and periodically review assigned vehicles to insure that vehicle master lists are correct.

PLANNING TASK FORCE--Established sometime ago within AF/PREE, the Planning Task Force will provide a central focus for all planning matters (AICUZ, Base Master Planning, etc.). This multidisciplinary group's first job is to provide civil engineers and commanders with the tools and techniques needed to build good defensible positions from which joint Air Force/civilian planning strategies can be developed.

REFUSE COLLECTION FLEET (LoDAL)--The single rear axle front loading refuse collection vehicle is allowed under the revised TA 010. Bases can choose between this unit and the tandem rear axle vehicle to best fulfill refuse collection requirements.

Air Force Logistics Command supports 12,697 aircraft, over 38,000 jet engines, more than 12,000 reciprocating engines, over 1,000 strategic missiles, and some 84,700 separate line items of equipment. Recognizing that modern methods and facilities are required to support these systems, here's a report on how the Command developed . . .

Modernized Logistics Depots

by John F. Maiorano, PE

To combat years of erosion in the Depot Plant which supports the Air Force Logistics Command (AFLC) mission, AFLC instituted the Depot Plant Modernization Program (DPMP) in April 1970. As the major command responsible for logistical support of the Air Force, AFLC provides the materiel and services to equip, maintain and sustain the operating forces. To carry out this responsibility, AFLC operates one of the largest industrial complexes in the country, with assets valued at almost $1.5 billion in current year dollars, split about equally between facilities and production equipment. This includes a physical plant for maintenance activities with facilities for aircraft modification, engine overhaul and repair, clean rooms for instrument repair, repair and calibration of precision measuring equipment, and a number of associated repair, rebuild and manufacturing capabilities. The industrial plant also includes a materials distribution complex encompassing storage, equipment management, packaging and transportation operations.

AFLC's support of the active and reserve Air Force, other federal agencies and allied nations includes 12,697 aircraft, 5.1 million flying hours, more than 38,000 jet engines and 12,000 reciprocating engines, over 1,000 strategic missiles, some 84,700 separate line items of equipment, and many major subsystems such as avionics, hydraulics and pneumatic systems.

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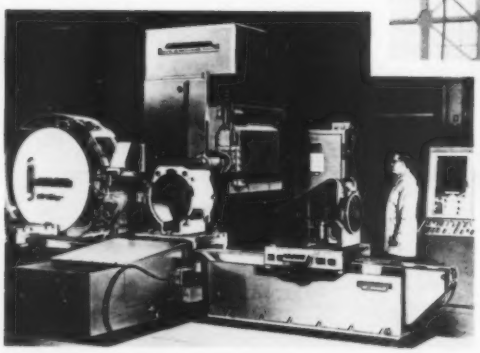
Modernized *cont'd*

Although the size of the forces supported provides an indication of the challenges involved in Air Force logistics, the real complexity of the task is related to the technical characteristics of the fleet, the diversity in operational concepts, and in deployment of the forces. Not only the size of the fleet, but also the use and age of the force pace AFLC's work. For example, 55 percent of the aircraft inventory is nine years old or older and is past its first line life, with many aircraft past their second line life. These aircraft, because of their heavy use and age, require the expenditure of intensified maintenance and overhaul efforts. On the other end of the spectrum is the 12 percent of the fleet which is no less than two years old. With the technological challenges associated with support of these weapons systems, the state of the art is being pushed to its limits, and modern methods and facilities are required to support the systems.

During the past two decades, two factors substantially influenced the condition of the AFLC depot plant.

- **First, operational requirements, including support of the Southeast Asia buildup, left very few funds to replace worn-out equipment and inadequate facilities composing the majority of the depot plant inventory.**
- **Second, workload consolidations were caused by a slimming-down of from nine to five AFLC Air Materiel Areas (AMAs). This resulted in work being accomplished in facilities that were either antiquated or not designed to accomodate the particular function that had to be assigned. At the lowest point, 75 percent of the Depot Plant had become substandard and about one-third of that was beyond repair.**

Aware that this erosion could not be allowed to continue without the risk of permanent damage to depot capability, AFLC instituted the Depot Plant Modernization Program (1) to relate depot facility and equipment requirements to a workload closely in consonance with the Five Year Defense Program which it supports, and (2) to provide vital visibility in



Goal of the DPMP is to provide an efficient aircraft flow line to increase productivity. Modern lighting, environmental controls and electrical power are features of MCP projects programmed. At the top, the Logistical Materiel Processing facility under construction at Hill AFB, Utah, will be linked to a warehouse and freight terminal by a transfer tunnel. In the center, airmen install an antenna on the vertical stabilizer of a F-105. At left, this numerically controlled turret lathe is an example of the type of equipment necessary to complement the modernization in the DPMP.

the annual quest for realistic funding. The DPMP procedure provided a means of systematically evaluating depot requirements in five-year blocks, thereby assuring necessary leadtime for future resource planning and more cost-effective utilization of funding provided. The plan called for an initial high dollar investment to regain modernized depot operating proficiency, and to be followed by annual funding on a lower investment level to assure continued maintenance of this proficiency when attained.

The DPMP, as a formalized program, was first submitted to higher headquarters in the FY 1972 Military Construction Program (MCP) cycle. AFLC, however, achieved significant support for its modernization efforts in the FY 1971 MCP with the approval of some $23 million for construction projects, plus almost $15 million worth of production equipment.

Of the $23 million approved for construction in the FY 1971 MCP, $15.7 million of the appropriation went for construction of an Aircraft Engine Overhaul Facility to replace nine substandard, widely dispersed buildings, many of which were **over 50 years old!** This new 543,000 square foot facility is a one story steel and masonry structure. It contains under one roof the repair lines for the overhaul and maintenance of some 1,600 engines per year. Prior to consolidation, this work had been performed in widely dispersed World War I truck shops and World War II warehouses which had a total of 37 miles of overhaul flow line. The new shop permits a reduction in the flow of engines to seven miles. In addition, $6.5 million worth of the latest mechanized handling equipment will enhance production methods to promote optimum efficiency and productivity. The improved processing has permitted a reduction of $10 million in engine procurement.

Figure 1: Total Investment Required for Five Year Program. (Million Dollars)

	FY-71	FY-72	FY-73	FY-74	Required to Compl	Total Thru FY-73
Facilities	(23.2)*	52.5	32.7	32.7	132.1	250
Equipment	14.7	22.1	25.8	26.9	50.5	140
	14.7	74.6	58.5	59.6	182.6	390

*** MCP forerunners, not included in total.**

The salient feature of the DPMP has been its requirement for fast amortization. Savings have been realized by modern facilities, coupled with up-to-date equipment. All DPMP projects have been fully justified on the basis of increased cost effectiveness and responsiveness to depot requirements. On the average, all DPMP procurements through FY 1974 have been self-liquidating in less than three years, with one-time savings and recurring annual savings totaling three times their investment costs.

The DPMP was developed by the AFLC staff, with major efforts by Civil Engineering, Maintenance, Distribution, and Materiel Management personnel, working in conjunction with a service engineering contractor, Tate Technical Service, Inc., of Glen Burnie, Maryland. Facility projects and equipment acquisitions selected for inclusion in the program require a present value analysis of cost versus benefit. Only those projects and acquisitions which pay for themselves are included in the program. Savings claimed in the economic analyses must be validated and follow-up procedures have been established to track and audit benefits to insure that the savings claimed are being realized.

JOHN MAIORANO *is assigned to the Programs Directorate, DCS/Civil Engineering, Headquarters Air Force Logistics Command, Wright-Patterson AFB, Ohio. He earned his bachelor's degree in mechanical engineering from the University of Delaware and his master's degree in business administration from Ohio State University. A registered Professional Engineer in Ohio, he is a member of the Operations Research Society of America.*

MCP projects identified as DPMP requirements have been funded in the FY 1972 and FY 1973 Military Construction Appropriations, and are included in the FY 1974 MCP currently before Congress and in the FY 1975 MCP under review by the Air Staff. While the level of funding has not equalled the amount requested in the original plan, there has been a four-fold increase over the level of funding received for modernization of facilities and equipment in the previous 15 year period. Funds provided in Fiscal Years 1972 and 1973 allowed upgrading or construction of 29 facilities, many in the multi-million dollar category. As an example, already approved DPMP funding will permit construction of Logistical Materials Processing Facilities (LMPFs) at four of the five AFLC AMAs.

An LMPF is a facility that, prior to the DPMP, was not recognized as a standard Air Force facility. This consolidated facility provides Distribution with operating efficiencies never before realized by centralizing the functions of receiving, unpacking, identification, routing, corrosion protection, packing and shipping of materials through the use of modern mechanized processing systems. LMPFs are under construction at Hill AFB, Utah, and at Kelly AFB, Texas. Contracts have recently been let for two more LMPFs funded in the FY 1973 MCP, at Tinker AFB, Oklahoma, and at Robins AFB, Georgia. The remaining AFLC AMA at McClellan AFB, California has an LMPF programmed for the FY 1975 MCP.

The LMPF is another prime example of what

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Depots *cont'd*

AFLC is attempting to achieve through the DPMP. The LMPF now under construction at Hill AFB, for instance, is a 400,000 square foot plus masonry facility sited near existing and proposed warehouses and the Air Freight Terminal, which consolidates functions now located in six widely separated buildings. The LMPF will include shipping and receiving areas, a container fabrication shop, repair shop, and logistics support space. Effective facility utilization is being developed around a totally mechanized material processing system supporting modern distribution requirements. Realization of this facility and its associated equipment will result in a $1.3 million one-time savings and annual savings of over $5 million as a result of increased productivity.

The total investment required for the five year program, FY 1972 through 1976, is presented in **Figure 1.** It is obvious that even though AFLC has received gratifying support for its program, it will be necessary to stretch modernization over a longer period of time to meet the original five year, $390 million target for modernization of facilities and equipment. Nevertheless, the level of funding to date will permit substantial improvements in AFLC's responsiveness with resultant benefits Air Force-wide.

The progress made to date in the DPMP will significantly enhance the capability of the organic industrial plant of the Air Force. Continuation of this program will assure a responsive plant that will be capable of keeping pace with the need to perform depot level maintenance, repair and modification on the complete line of aircraft and supporting systems in the Air Force inventory. CE

LETTERS

To the Editor

Wrong Command

Dear Editor:

The May issue of the Air Force Civil Engineer contained a glaring error on the back cover when you inferred that Sergeant Hammes, a member of the 63d Civil Engineering Squadron, was in the Air Defense Command (ADC).

Request a correction be printed in a future issue.

CHARLES W. NYQUISE, Colonel, USAF
63 Air Base Group/DE
Norton AFB, California

It's done and our apology to Sergeant Hammes of Military Airlift Command.

The Editor

Cites Miscalculation

Dear Editor:

The article "Managing Your Bank Roll Better" by Maj Norbert O'Hare which appeared in the May 1973 edition of your magazine was timely and certainly needed during this period of increased financial austerity. However, there was an error in the method of determining that portion of a shop rate which is considered reimbursable and charged to the monthly Schedule of Reimbursements and Refunds.

Major O'Hare states that "if the carpenter work center has five military and five civilians assigned, the military factor is 50 percent (5/10) and only 50 percent of the shop rate cost will be reimbursed." This is not the method detailed in AFM 85-200. The military factor as loaded in the BEAMS Shop Working Logistics (SWL) file must be equal to the dollar percentage of Military Personnel Expenses (EEIC 2XX) involved in the computation of the Shop Rate. While the manning ration will have an effect, the shredout of the funded vs. unfunded portions of a shop rate is based on the percentage of dollar costs of the various EEICs constituting the total Estimated Fixed Cost Center Expense for a fiscal year. These percentages are then used in the generation of the Schedule of Reimbursements and Refunds. Having had a hand in the design of the BEAMS Shop Rate Analysis Report, I can assure you that the procedures for determining funded and unfunded portions of the Shop Rate remain an area of some confusion. Perhaps an article on the Shop Rate including philosophy and procedures would be suitable for a future issue of your magazine.

CHARLES F. ZURLA, Captain, USAF
Air Force Data Systems Design Center
Gunter AFB, Alabama

Thanks for your comments. Major O'Hare agrees. By the way, why not write the article on the Shop Rate? We'll be more than happy to publish it.

The Editor

Appreciates Mapping Article

Dear Editor:

In your May 1973 issue of the Air Force Civil Engineer (page 7), there is an exceptionally well written article on our Defense Mapping Agency. The story was authored by Maj Darrell G. Bittle, PE, and Norman L. Levine of the Defense Mapping Agency Aerospace Center.

Because of the accuracy of information contained in this article, and due to its timeliness, we find the report to be both useful and adaptable for our own further circulation. Its wide circulation in your magazine will undoubtedly have the desired effect of getting the information to those who can use it.

We have sent a letter of appreciation to the authors through their command channels. Additionally, we wish to express appreciation to you for printing the article and congratulate you on a very professional publication.

JAMES H. WATKINS, Major General, USAF
Acting Director
Defense Mapping Agency
Washington, D.C.

"Smiple" Objectives

Dear Editor:

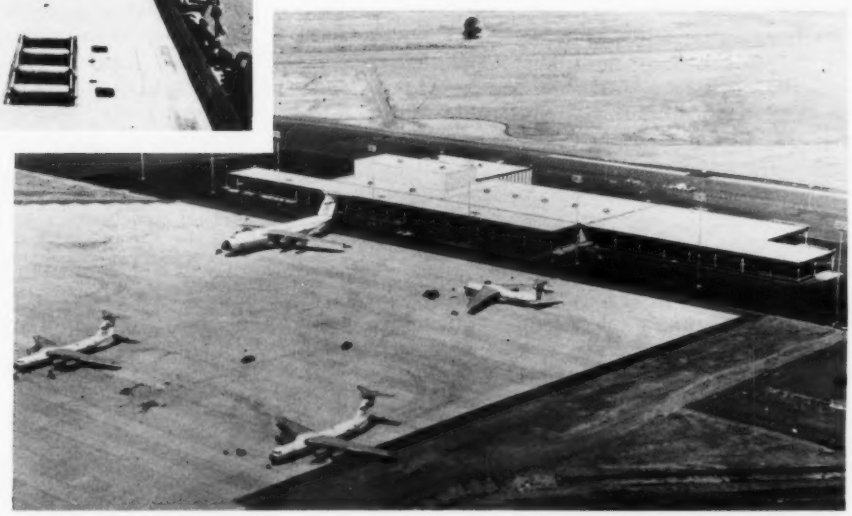
In my article on "Management by Objectives", (See August 1973, Air Force Civil Engineer) I used the expression "Management by objectives is that smiple." From the letters and calls since, it seems that quite a few of my friends either do not understand smiplicity or cannot comprehend a smiple sentence.

For them, I have written and reproduced a paper on objectives that include all steps and all forms required to make and run an objective program. It is short, clear and illustrated.

If anyone wants copies, they can get in touch with me and I'll send them "Objectives Made Smiple."

J. RICHARDSON JOHNSON
Professor of Management
Civil Engineering School
Wright-Patterson AFB, Ohio

To effectively utilize the tremendous cargo potential of the C-141 and C-5 force, Military Airlift Command Civil Engineers and planners were faced with a unique challenge. Here is the report on the key concepts of the new generation of Air Force freight terminals.



An advanced design in air freight terminals is the facility soon to be completed at Travis AFB, California (right). At the top, Military Airlift Command's 463 L mobile equipment system extracts cargo from the Air Force's largest cargo aircraft, the C-5.

Breakthrough in Air Cargo Terminals

by Capt John F. Gaver, EIT

Editor's Note: The following article is the second in a two-part series which reports on the efforts of Military Airlift Command to provide streamlined, modern facilities in support of the Air Force mission. The first article was published in the May 1973 issue and described the bold design in Air Force passenger terminals.

The advent of the Military Airlift Command (MAC) "all jet" cargo fleet in the mid-1960s and early 1970s required revolutionary ideas in design and construction of air freight terminals to effectively utilize the tremendous potential of the C-141 and C-5 force. Prior to this time, air freight terminals were designed to support C-54 aircraft and were slowly expanded in an effort to keep pace with the increased capabilities of the C-97, C-124, C-118, C-133 and C-130, as well as other cargo aircraft. The C-5 is capable of airlifting up to 10 times (110 tons) as much cargo in one-third the time as the aircraft that influenced the designers of the old generation air freight terminals.

This breakthrough in airlift capability presented a unique challenge to MAC Civil Engineers and transportation planners. Preliminary investigations showed that a linear expansion of existing facilities to match airlift capabilities would be regressive and that a new approach utilizing the knowledge of the recognized leaders of air cargo process systems engineering was necessary. To this end, an architect-engineering

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Breakthrough *cont'd*

CAPTAIN GAVER *is a Civil Engineer, Construction Management Division, DCS/ Civil Engineering, Headquarters Military Airlift Command, Scott AFB, Illinois. A graduate of the University of Nebraska with a bachelor of science degree in civil engineering, he is an Engineer-In-Training in Illinois. He is a member of the Illinois Society of Professional Engineers.*

firm specializing in the design of cargo terminals, was selected to develop a definitive package for all future air freight terminals. This firm had accomplished the planning and design for a major portion of both domestic and international air carriers and was considered a leader in air cargo process system engineering.

In July 1968, Dortech, Inc., was awarded a $99,000 contract by MAC to develop a family of definitive designs in nine months. The contract was divided into three phases. First was a study phase. The architect-engineer (A-E) reviewed all previously completed studies, particularly Air Logistics 70 for the 463 L mobile equipment loading and unloading rates; Terminal Facilities 73 for the number of aircraft requiring simultaneous servicing; and the ASD Douglas report for the weight, shape and dimensional characteristics for all Department of Defense cargo. The A-E also received detailed briefings from the MAC staff on the concept of freight terminal operations.

Second Phase Includes Several Concepts

The second phase included the development of several concepts and the selection of a single concept applicable to MAC. The second phase then developed the approved concept into a family of definitive terminal designs. The definitives consisted of small terminals of 200, 400 and 600 tons per day capacity considered suitable for inland ports; the medium terminals of 1,000, 1,500 and 2,000 tons per day capacity considered suitable for most major ports; and the large terminals of 3,000, 4,000 and 6,000 tons per day capacity to provide increased capability for the future. The third phase was completed, reviewed and approved in May 1969.

The design, during the third phase, was based on four primary objectives that had been developed and agreed to jointly by the MAC staff and the A-E. First, an integrated design for the materials handling system and the facility was required to provide for optimum efficiency at minimum cost. Previously, the facility was designed and built and the equipment fitted into the warehouse type building. This proved unsatisfactory, as the equipment cost more to install and, in many cases, the newly completed building had to be modified. Second, the system had to be flexible. It was essential to have the capability to exercise management options that would allow system expansion to fit the contingency at hand. The system also had to be flexible enough to respond to the differing concepts of operation at each location. Third, the system had to lend itself to modular, incremental expansion without disrupting existing operations. Fourth, the cost of the air freight terminal complex as a whole was to be minimized rather than attempting to cost each component separately.

Along with the design objectives, specific ground rules for the design were also developed. Since all of these criteria were satisfied by the final design, they provided a good overview of the capability of the terminal system. A definition of terminal capacity was the key to the design. "Air cargo in" plus "air cargo out" was adopted knowing that this definition contained an inaccuracy in that transfer cargo was counted twice. Therefore, the number of aircraft to be serviced simultaneously had to be determined. The peak number of aircraft to be serviced became the design criteria which governed system capacity. Actual data was collected and used as the basis for the maximum number of aircraft on the ground at one time. A minimum of one C-5 position was established as a ground rule since this would provide the capability to ship oversized goods from all ports. The

In addition to the Travis AFB Freight Terminal, MAC has completed or is in the process of completing other freight terminals. The following is a summary of MAC's freight terminal program.

	Location	Size (SF)	Cost ($000)	Completion	Remarks
A.	**New Terminals:**				
	Dover	247,500	5,719	Aug 73	Additions/alterations to existing facility to achieve a definite design similar to Travis
	Mildenhall	77,000	2,411	Apr 74	
B.	**Additions/Alterations:**				
	Charleston	99,503	1,687	Sep 72	24,000 SF for administrative space, balance for cargo processing
	Kadena	10,000	171	Sep 72	3,500 SF for admin & 6,500 SF for cargo storage
	Norton	121,500	2,032	Aug 69	
	Ramstein	15,000	295	May 73	Admin & cargo processing
	Yokota	43,713	392	Oct 73	

truck arrival and departure pattern was developed from experience with over-the-road truckers and checked against the existing Travis AFB pattern to insure reasonableness. The cargo storage capacity was set at two days equivalent weight of cargo. This meant that, within the system or in pure storage, two days of export cargo was available.

A requirement was placed on the designer to develop a terminal/mechanized material handling system which could be expanded or overloaded to handle contingency or emergency operations. A minimum of 200 percent was established as a goal. Since the 463 L mobile equipment was already on hand and represented a sizeable capital investment, the decision was made to incorporate this equipment into the design whenever possible. Using the ground rules and design objectives outlined above, a series of mathematical models were developed to describe all of the internal and external functions associated with the terminal facility. Rates of cargo flow were established and from these, equipment was selected, sized and placed into an optimum configuration. When this was completed, the air freight terminal definitive designs for the physical plant were developed.

MAC Authorized as Design Agent

As stated earlier, a final definitive design was approved by MAC in May 1969. Then the 1,000 ton per day nominal capacity terminal definitive was selected for site adaptation for the FY 1970 MCP terminal at Travis AFB, California, and the FY 1971 MCP terminal at Dover AFB, Delaware. Headquarters MAC was authorized as the design agent for the Travis AFB air freight terminal and a design contract was awarded in August 1969.

Five additional MCP projects were required in the FY 1970 program to support the air freight terminal, bringing the facility cost of the terminal complex to $10,300,000. These projects provided an access taxiway, an aircraft loading apron with a hydrant fueling system, a water main extension, a road relocation, and paved truck load/unload area. The taxiway project was started in August 1970 and was completed in June 1972 at a cost of $1,350,000. It provides access from the existing airfield pavement to the new loading apron. The aircraft area or loading apron contains approximately 156,000 square yards of pavement with the capability of handling two C-5 and six C-141 aircraft. Along with the parking apron, a hydrant fueling system was installed with 10 dual outlet fueling points and a fueling rate of 3,600 gallons per minute. Simultaneous fueling can be accomplished on two C-5s and one C-141 at fueling rates of 1,200 gpm and 900 gpm, respectively.

Fuel storage tanks with a capacity of 420,000 gallons along with three 1,200 gpm pumps were also provided. Work on the loading apron and the fueling system was started in August 1970 and was completed in June 1972 at a combined cost of $3,600,000. The truck load/unload area consists of 217,000 square yards (45 acres) and cost $1,481,000. This paved area provides parking for 80 tractor trailers and 150 POVs, a holding area for 700 tons of cargo, and parking positions for 150 percent of all materials handling equipment authorized.

The terminal building, essentially a 200 foot by 1,083 foot rectangle, emphasizes the logic and function of its use. It has 10 primary truck docks, with 11 additional docks to support the mail room and the baggage inspection room. Fifteen pallet pits are provided for the buildup and breakdown of pallets. Additionally, five oversize pallet buildup stations are located in the outsize cargo area. A covered 50,500 square foot pallet storage and queing area serves to store and sequence pallets for onload to the aircraft via 463 L mobile cargo handling equipment. From a technical standpoint, the terminal facility encompasses the following construction features:

- Footings: spread reinforced concrete with conventional grade beams.
- Columns—Beams: structural steel.
- Exterior walls: pre-coated 22 gauge steel siding with 1 inch thick fiberglass insulation. Office area has 8 inch CMU with metal siding.
- Floors: 8 inch reinforced concrete slab.
- Ceilings: office area has suspended acoustical tile.
- Roof: 1½ inch metal deck with maximum 6 inch perlite fill with 2 inch insulation with two-ply build-up roof.
- Scope: 225,000 square feet.
- Construction time: 540 days.
- Construction cost: $3,484,000.

The terminal building maintains 22 feet of clear height between floor and steel joist except in high bay stacker area which provides 40 feet of clear

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Three 25 K-loaders prepare to onload a portion of the cargo that the C-5 Galaxy is capable of transporting.

Breakthrough *cont'd*

height for the towcart stacker device.

The Mechanized Materials Handling System (MMHS) contract, awarded in February 1972 using the two-step approach for $5,600,000, has an estimated operational date of December 1973. The MMHS is essentially a grouping of cargo handling equipment, i.e., single pallet handling/storage subsystem; single, dual and multi-pallet elevating transfer vehicles; single and multi-pallet buildup/breakdown stations; towline subsystem; towcarts and stacker; and pre-palletized docks. The two step approach, considered the best way to obtain the latest developments within the industry, insured that the system would not be obsolete prior to installation. The system design maximizes the use of parts that are readily available and highly reliable to minimize maintenance. The MMHS contractor is required to conduct a training program in the maintenance and operation of the system prior to final acceptance by the Air Force.

The key concepts of an integrated mechanized handling system, preplanned expansion of all components, and flexibility to meet contingencies have all been incorporated in this new generation freight terminal complex. These concepts were achieved through a close co-ordination process between MAC and Air Force Logistics Command. This process will allow one to visit the largest mechanized cargo handling terminal in the Air Force this fall, five years after conception. Completion of this state-of-the-art system will insure a smooth and efficient flow of cargo through Travis AFB later this year and Dover AFB in 1974. CE

MacKenzie Named Director

Lt Col James S. MacKenzie was named Director of the Civil Engineering School, Air Force Institute of Technology, Wright-Patterson AFB, Ohio on 19 September 1973. He replaces Col Walter Grande who retired on 1 September.

Colonel MacKenzie is the 11th head of the School since its establishment in 1948, and is the third former faculty member to return to serve as its Director.

New Subscription Rates

Subscription rates to the **Air Force Civil Engineer** journal will be increased as of 1 January 1974. The new rate is $2.15 per year domestic, $2.70 for foreign mailing, and $0.60 per single copy.

Those interested in a personal subscription should send their check or money order to the Superintendent of Documents, Government Printing Office, Washington, DC 20402.

COL BERNT BALCHEN

Air Force Civil Engineering lost two valued friends and avid supporters of civil engineering programs with the passing of Lewis E. Turner and Col Bernt Balchen recently.

Colonel Balchen, who is best remembered as the pilot for Admiral Byrd in the first crossing of the Antarctic in 1929, and since that historic expedition, had become one of the most listened to experts of frozen lands in the world, died in Mt. Kisco, New York, on 17 October 1973 after a long illness. The Norwegian born airman flew 15 times over the North Pole and twice over the South Pole. He was made an American citizen by Act of Congress and was commissioned into the US Air Forces in 1941. He was recalled to active duty in the Air Force in 1948 and later became a special assistant on Arctic problems to the Air Force Chiefs of Staff.

Colonel Balchen was known to many Air Force Civil Engineer Officers. He was a featured speaker in the Base Civil Engineer course offered by the Civil Engineering School at Wright-Patterson AFB, Ohio, over the past 12 years.

LEWIS E. TURNER

Mr. Turner, Acting Assistant Secretary of the Air Force (Installations and Logistics) died as the result of a heart attack on 5 August 1973 in Washington, DC.

Mr. Turner began his career with the Government in 1940 with the Civil Service Commission, later moving to the General Accounting Office and the War Production Board. At the end of World War II he became associated with the War Assets Administration where he worked as a budget officer. When the Air Force became a separate service, he was asked to join the Air Force Budget Office to assist in establishing a management and budgeting system.

He moved to the Office of the Secretary of the Air Force as Deputy Assistant Secretary (Financial Control) in 1959. He left the government service in 1961, and after three successful years in private industry, he returned to the Air Force in 1964 to assume the position of Deputy Assistant Secretary for Installations. He was appointed Acting Assistant Secretary of the Air Force (I & L) on 1 October 1972.

The People Side of Civil Engineering Within USAFE

by Brig Gen Robert C. Thompson

Over the past few years, the objective within USAFE has been to establish a living and working environment that satisified not only the physical but social needs of its people. Civil Engineering has been very much involved and here's the report on the effort.

From cook to civil engineer to photo interpreter to pilot, these men and women all have a part in keeping their RF-4C Phantoms flying in support of USAFE's role in the NATO mission.

As a prelude to addressing the "people" interest in US Air Forces in Europe (USAFE), some discussion is in order on the command, and how civil engineering is uniquely organized to support it.

There are 26 primary bases and 396 smaller installations in USAFE stretching from Turkey to Scandinavia. At the present time, all fighter wings in the command are equipped with front line aircraft and several USAFE bases are geared to receive dual-based squadrons from the CONUS.

The command operates three numbered air forces: 3rd in England, 16th in Spain, and 17th in Germany. In the eastern Mediterranean area, Headquarters TUSLOG at Ankara exercises command jurisdiction over all major USAFE units in Turkey and acts as USAFE's single point of contact with the US ambassador in that country.

The 4th Allied Tactical Air Force (4 ATAF), headquartered at Ramstein AB, Germany, is a NATO command to which the great bulk of USAFE's units are committed. CINCUSAFE is also commander of 4 ATAF, and the USAFE aircraft under his control, earmarked for NATO use in time of war, constitute the largest single air contribution of any nation in NATO.

The interrelationship between USAFE and NATO leads into an area of considerable interest, having to do with the relocation of USAFE headquarters from Wiesbaden to Ramstein AB in order to insure positive command and control of the 4 ATAF in the event of hostilities. In this case, the CINCUSAFE must be in a position to immediately assume direct command and integrate key members of the USAFE battle staff into the NATO structure. With a 75 mile separation between Wiesbaden and Ramstein, this was somewhat unrealistic. The move will definitely provide a more efficient, streamlined command and control structure and will greatly simplify day-to-day USAFE/4 ATAF business.

The civil engineering effort to move the headquarters was significant, and work is now essentially complete at Ramstein AB. Most of the construction work was done by in-house forces, primarily the 86th TFW Base Civil Engineer (BCE), the 7002 Civil Engineering Flight, USAFE Prime BEEF personnel, and an Air National Guard/Air Force Reserve team from the CONUS.

One factor that never was forgotten was that we were providing an environment in which our people were to work and live, and our attitude was that it should be as pleasant and desirable as possible. We found that this **could be done by the prudent application of imagination and very little else.** In many cases, such as with painting, only a selective application of colors instead of the repetitious monotones, made the difference, since paint had to be applied anyway. Where added costs were involved, they were minimum, as the idea was to be concerned and interested in a person's environment, and money alone

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The People Side

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cannot achieve that objective.

The headquarters move increased the number of military families in the Ramstein area by some 750. To ease the grade school situation, 25 relocatable classrooms were erected at Ramstein AB by the opening of school in September.

Again, the thought was not just to throw up the required number of classrooms to satisfy the increased number of children. This could have been done quickly and easily by clearing an area and erecting the buildings in a row. Instead, the siting made maximum use of the surrounding area by placing the classrooms in a pattern where trees surround each building and walking paths provide easy access from one to the other.

It seemed like "people" things were being talked about incessantly in early 1972 and an assorted number of ad hoc groups were being established to try and sort out the needs and desires of people throughout the command. However, each of these groups went about their business as a task and when the sought after information was obtained, the group then either went to another problem or was disbanded. In either case, the effort to deal with people requirements and problems was at best fragmented.

It seemed quite clear that the entire program needed full time effort and management. This requirement resulted in the establishment in USAFE of the Deputy Chief of Staff for Engineering and Services, a heretofore unheard of function. It established a single agency responsible for all aspects of community development, **and is based on the premise that engineering and services are closely related, and must be combined to assure total program management from beginning to end, including operation of the activity.** The objective is to establish a living and working environment that satisfies not only the physical but social needs of our people.

The concept is quite simple. In engineering and services, we concern ourselves with the total environment in which our people live, work and play. Programs are being developed with the total needs of everyone in mind—not only from the traditional facilities standpoint, but from an interrelated planner/provider/maintainer/operator point of view.

GENERAL THOMPSON *is Deputy Chief of Staff for Engineering and Services, Headquarters United States Air Forces in Europe, Ramstein AB, Germany. He began his military career in 1942 and has been a civil engineer since 1944, holding responsible positions at command, numbered Air Force and base levels. He has both his bachelor's and master's degrees from the University of Maryland.*

Engineering and services have responsibility for commissaries, dining halls, clothing sales stores, class VI stores, laundry and dry cleaning and last, but not least, mortuary affairs. At the present time, the author is also Chairman of the European Exchange and Motion Picture Service Council and Class VI fund councils, and a member of the board of the Exchange and Motion Picture Services in Dallas, Texas. Some may wonder what all of this added responsibility really does for USAFE and the Air Force.

Ties Programs, Concepts Together

Primarily, it ties several of the previously fragmented community support programs and operating concepts together. Our posture goes from one of reaction to one of improved control. We don't have all support functions, but are now virtually on top of the traditional problem of tying programs and sources of funds in the support area into a more manageable package. This channels **all** resources toward a common goal—**better service for the customer.** For the first time we are able to effectively coordinate and control virtually all of the money programs for facilities, including the use of monies other than MCP, P-341 and family housing. We are now able to manage the expenditure of commissary surcharge and class VI funds and have tight reins on nonappropriated funds, EES, motion picture, clubs, Stars and Stripes, dependent schools, and other sundry funds that go into projects for improvement of facilities or operations.

With dollars as short as they are these days, we must continually search out and employ all possible sources of funds. In addition to those already mentioned, USAFE has been fortunate enough to be a beneficiary of another very important source of money —German marks made available as a result of the US-Republic of Germany Foreign Exchange Equalization Agreement of 1971, commonly known as the Offset Agreement. The command so far has received $7.2 million, and we have put it to good use in the Airmen Dormitary Improvement Program. There are 116 Air Force dormitories in Germany and 77 are included in the current dormitory improvement program. The first dorm went under contract in April 1972, and the entire program should be completed shortly. Much of the money had to go into hidden work, plumbing, structural, and the like, but we were careful to achieve the visibility and improvements that each airman could see and know that this was his program.

The current program is limited to dormitories, but negotiations are in progress for a follow-on effort. We would like to expand the scope of this phase to include many other facilities and this could become an important part of our better living program in the future.

In new dormitories and other facilities in Europe we are pushing a program to install carpeting whenever possible. In existing facilities we are looking

hard at all projects to replace old and worn out flooring with carpet. Many don't realize it, but carpeting is very durable and cost effective if properly bought, installed and maintained. It helps create the atmosphere we have all been thinking about, but never quite got around to providing. In USAFE, we have made the BCE the "carpet czar" and have given him written guidelines—how to select, buy, install and maintain carpet. We are going away from the traditional institutional atmosphere of our community and administrative facilities—no more sterile white or pale green walls room after room. We select interior decor tastefully, considering the needs of the individual. It doesn't cost any more—it just takes a little initiative and forethought on the part of our civil engineers and managers.

"We Try Not to Overlook Very Much"

Civilian and military architects within USAFE have been put to work in areas related to their education and training. We try not to overlook very much—the dependent schools (USDESEA), the Stars and Stripes, the exchange service and theater people, and numrous others are all brought together to better satisfy social / recreational /educational / shopping needs of our people. We now have multi-million dollar programs with the exchange service to construct shopping centers at four bases—Hahn and Spangdahlem, Germany; RAF Lakenheath, England; and Incirlik, Turkey. A fifth at RAF Upper Heyford is under construction. The new centers will take full advantage of existing community facilities—close streets, construct parks and reroute traffic as required to provide pleasant, functional areas.

Most of the bases in the Air Force have the elements required to establish an effective and pleasant community center. But, as is the case with Incirlik CDI, all of the individual functions are separately managed and developed, each without regard to the other. The parking areas and roadways cut through the middle and give too much priority to the vehicle and little or none to the pedestrian. By rerouting the main traffic around the center area, transforming much of the asphalt areas to grass or patio style malls, and managing the development of facilities to ensure that this development is consistent with the entire center development, we are able to achieve the objective of having a gathering place for people to meet without the challenge of competing with cars.

An area is provided for leisure time sitting, talking, mingling and social interchange, in addition to the shopping offered by the retail outlets. By being readily available and desirable for everyone, including those people without the economic resources for more expensive activities, an extremely important social need is satisfied. Attractive and pleasing community centers are a source of recreation and, for many people, provide a way to relieve boredom and spend leisure time.

We are providing washaterias with hair dryers for the ladies, dining halls and dormitories with attractive and comfortable surroundings for the airmen and schools for the children with adventure playgrounds, soft sand areas, and imaginative playground equipment. For too many years, we have been hooked on the stereotyped and drab inevitable expanse of asphait, cyclone fences and tubular steel.

We don't have to do it the old way—all it takes is forethought, imagination and a willingness to change. A **little initiative enables us to tie it all together in the early stages of development and carry one or more well integrated programs through to completion.** This gives one a true feeling of accomplishment and self-satisfaction. It challenges the imagination of our younger civil engineer officers, civilians, airmen and even some of the old heads. We talk about providing job satisfaction and creating the atmosphere that encourages self-motivation—we believe nothing does it better than a real effort to improve things and to refresh our thinking with new ideas and concepts.

Service is big business in USAFE and fits into our overall program. We have been talking about more than just providing a facility where one goes to buy socks or milk, or sleeps for eight hours. We are interested in operating these facilities in a way that will give better service to our people.

We must put our imagination to work. It is amazing what turns up. We have multi-million dollar complexes that sit idle many hours a week. About a year ago, we opened the shopping center at Wiesbaden on Sundays and have averaged 2,000 customers an hour through the doors. The commissary was opened as well. The same thing has now been done at Ramstein, and we are also looking at the possibility of using our dependent schools 12 months a year.

It's a tough, challenging, but rewarding task. There is a lot of work to be done. Civil engineers Air Force-wide need to get involved in total community development.

Our product, no matter what it is, should be customer oriented. We want to serve the housewife, the airman, the children, and of course, the commanders. It all adds up to a successful mission. It's not all on the flight line. CE

Flags of the countries that make up the NATO Alliance stand near new USAFE headquarters building, Ramstein.

AIR FORCE RESERVE

Civil Engineering forces of the AFRES have adapted well to their new mission, earning for them the reputation that . . .

Quality Work Is Their Hallmark

by Maj Matthew M. Cafiso

With the Department of Defense announcement that the reserve forces would constitute an integral response element of future United States military forces in any contingency, the Air Force Reserve (AFRES) Prime BEEF mission has taken on a new and more demanding role. Initially, the reserve objective was to provide a force nominally prepared to respond with trained "filler" personnel to active force units that had been depleted by deployments in support of contingency operations. These active force requirements would result from worldwide Air Force operational resources deployed at Prime BEEF forces comparable to those sent to Korea during the Pueblo Crisis in 1968.

This new reserve role became one of being the contingency force that would deploy to support active force units in the field. These forces would require extensive retraining to assume full responsibility for acting as a fighting force in the real-world combat environment. The training gaps between the old and the new missions were significant. On the one hand, providing individual personnel with skills to satisfy vacancies created by active force deployments, and on the other, to provide response for the active force at some forward "bare base" location where the unit was the initial and on-going action agency to support sustained operational flying mission requirements under the most adverse of environmental and combat conditions.

Training, of course, would provide the basic building blocks of any such force, but experience would provide the materials necessary to hold those blocks together. And experience was the one factor that was missing in past programs.

A new Prime BEEF training program was initiated late in 1970 to provide the critical missing element and to assure a truly responsive force. This program has generated a novel approach to providing realistic reserve training while offering an invaluable by-product: facility support to the active force. The reserve Prime BEEF program, over the past three years, has had a significant impact upon the facility posture of the active force, whether in the area of dormitory rehabilitation programs sponsored by the major commands under Project Volunteer, or the upgrading of the aircraft "boneyard" at Davis-Monthan AFB. In each instance, AFRES Prime BEEF has

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. . . erecting a shelter

. . . deploying to a base

. . . checking out plans

AIR NATIONAL GUARD

Civil Engineers of the ANG have full time civilian occupations in the same career field, which results in . . .

A Highly Professional Force

by Maj James H. Sams, III, PE, and Henry Sauter

Prime BEEF in the Air National Guard, unofficially designated ANGUS (Air National Guard of the United States) Prime BEEF, is completing its fourth year, and the results are satisfying to the involved members of the ANGUS Prime BEEF teams and their "customers:" the Air Force and ANG bases around the country and the world. ANGUS Prime BEEF Teams are being trained and equipped for an integral role in the Total Force policy in this manner:

- ANGUS Prime BEEF-C/F Teams must be able to deploy to any designated point worldwide for civil engineering functions in support of contingencies. These 60-man teams can deploy as F-Teams (with their parent flying unit) or as C-Teams (independent of the parent flying unit) as required by the appropriate war plans. In either mode, they must be prepared for deployment within 28 hours, the same as active force teams.
- ANGUS Prime BEEF-FF Teams must be able to deploy to any designated point world wide to provide firefighting support to designated operations.
- ANGUS Prime BEEF-R Teams must be capable of restoring base facilities following an attack or natural disaster, and must be capable of operating them on a multi-shift emergency basis for 36 hours, or until normal service is restored.

In preparing for their role in the Total Force, ANGUS Prime BEEF Teams undergo the same rigorous training as their active force counterparts, under the auspices of the Air Force Civil Engineering Center (AFCEC) at Tyndall AFB, Florida. For C/F Teams, this training consists of an exercise to complete assigned projects, such as the erection of revetments, AM-2 matting, airfield lighting, etc., under the pressures of limited time and simulated combat conditions. For R-Teams, the training involves disaster response exercises. All exercises stress leadership as the key ingredient.

As a part of their training, all team members must continually upgrade their AFSC specialty skills in order to be well prepared when the call comes. This could become a significant problem for a force that is training under part-time conditions, except that most craftsmen in ANG units have full time civilian occupations in the same career field. This leads to some rather unique circumstances, such as an airman just out of technical school who is a full-fledged journey-

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a rescue exercise . . .

pouring a foundation . . .

hot pit fire training . . .

Quality Work

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played a part in improving the overall Air Force facility picture, particularly with two notable benefits: (1) good, solid, meaningful training for the reserve people; and (2) considerable dollar savings to the Air Force.

There are 34 civil engineering flights within the AFRES. To assure a fully manned 60-man "C" team can be fielded in the event of a contingency, these flights are configured with 85 personnel. The remaining 25 men would be used to support host Base Civil Engineers (BCEs) at the mobilized locations, or could be used to support other Air Force deficiencies at active duty stations. The skills and experience within the flights are comparable to those available within the active force Prime BEEF teams. Since the advent of the new training program for reserve Prime BEEF, all of the teams have been deployed from their home stations during their summer training active duty tours to support active and reserve forces projects. These deployments provide a taste of working in strange environments, with unknown support personnel (See **Figure 1**).

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Some of these deployments are continuing programs sponsored by the gaining commands. For instance, every summer four Prime BEEF teams deploy in support of the Alaskan Air Command. This makes possible the release of active duty personnel for leaves and personal business without disrupting the critical base engineering activities. Simultaneously, the Prime BEEF teams have constructed the Oklahoma air-to-ground gunnery range and the new modular dorms at Galena AS.

The latest innovation in this program has been the deployment of Reserve Prime BEEF teams to USAFE and PACAF. During this calendar year, reservists have provided assistance in upgrading dorms at Wiesbaden AB and Rhein-Main AB, built a security building at Zaragoza AB, Spain, and, in general, added to or improved the recreational and operational facilities at three USAFE locations. In addition, at Wiesbaden AB, they constructed a 6,000 square foot relocatable structure to be used as a forward supply point for the host base support of all vehicle supplies in Europe.

These were all scheduled training sessions for the reserve teams, planned and executed as training projects. In addition, on a volunteer basis, Prime BEEF teams have assisted in the relocation of Headquarters USAFE from Wiesbaden AB to Ramstein AB; provided fire-fighting support to TAC, MAC and US Readiness Command during programmed exercises; supported short-falls in personnel during the recent "Bullet Shot" operation, reconfigured structural components of the relocatable aircraft shelters for use with new weapons systems at Upper Heyford

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Figure 1: CY 73 Deployments

No. Teams	Host Command	Project
2	PACAF	BCE support at Hickam AFB.
2	AAC	Construction of modular dormitory facilities at Galena AS.
2	AAC	Project Volunteer dormitory rehab project at King Salmon.
4	MAC	Project Volunteer dormitory rehabilitation at Altus, Travis, and Charleston AFBs.
4	TAC	Support of advisory base engineers.
1	AFLC	Erection of 40 foot x 100 foot relocatable building for base support at Tinker AFB.
1	AFRES	Construction of corrosion control facility for F-105s at Tinker AFB.
9	AFRES	Construction of RED HORSE complex at Ellington AFB.
2	AFRES	Construction of RED HORSE complex at Ellington AFB.
3	AFRES	Construction of air-to-ground gunnery range to support active and reserve fighter training, Ft. Sill, Oklahoma.
2	USAFE	Dormitory rehabilitation project at Rhein-Main AB.
1	USAFE	Relocatable building to be used as forward supply point for vehicle spare parts at Wiesbaden AB.
1	USAFE	Construction work at Zaragoza AB, Spain.

Professional Force

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man electrician, or a technical sergeant equipment operator who is a contractor in civilian life. Needless to say, this can only result in a highly professional force when multiplied by the many skilled tradesmen who are voluntarily a part of the ANGUS Prime BEEF Teams.

The capability available in these teams can be used to substantial benefit by any Air Force or ANG base willing to do a bit of planning and co-ordination. Each of the 93 ANG Civil Engineering Flights which include Prime BEEF Teams must put in a 15-day annual training period each year, which in many cases involves a deployment to some base for projects to provide skill training to team members. In past years, the projects have ranged from pavement repairs to dormitory improvements to erection (or dismantling) of B-58 shelters and other buildings. Interesting, worth-while projects should be proposed by major air commands to the AFCEC, which then transmits to the National Guard Bureau (NGB) in Washington those that have both priority (for the base) and training potential (for the team). The National Guard Bureau selects teams for the various projects and obtains the necessary approvals.

A recapitulation of CY 1973 deployments by ANGUS Prime BEEF Teams shows that:

- 18 teams deployed to other ANG bases.
- 32 teams deployed to Air Force bases.
- 43 teams accomplished home-station projects.

ANGUS Prime BEEF deployments are fitted into a three-year cycle. In the first year, any given flight accomplishes a four-day training program, followed by a shortened deployment or return to home station. In the second year, the flight is deployed; and in the third year, it works at its home station. Then the cycle begins anew. So, roughly one-third of the flights are available for a 15 day deployment in any given year.

Planning for ANG team projects is based on a minimum work period of 88 hours per man over a 15 day period. This allows one full day of travel at each end of the deployment and two days off in the middle of the work projects. The result is 11 eight-hour work days. (Consistently, ANG teams have worked longer hours).

The man-hours available for any given flight must necessarily be an estimate based on variations in numbers of personnel available. In the ANG, annual training is accomplished at the time most convenient to the unit, to the Guardsmen, and to the employers of the Guardsmen. Perhaps 10 or 15 percent of a flight may miss a deployment because of employer requests; however, these men make up the training at their home station at a later date. Calculations can be based on an average of 50 men, and these men will be working for 11 days. (A normal two weeks equals 80 hours, or 4,000 man-hours; 88 hours equals 4,400 man-hours. A round figure of 4,400 hours would be a good figure on which to base any planning.)

When a team chief looks at available projects, he asks himself: "Is this project worthwhile in terms of training for the Flight? Will all skills be utilized? Or (for example) is it heavy on equipment, with nothing for the electricians?"

The kind of performance that can be expected from ANGUS Prime BEEF can be termed better-than-

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MAJOR SAMS *is a Civil Engineering Staff Officer in the Civil Engineering Division, National Guard Bureau, the Pentagon, Washington, DC. A graduate of Clemson University in civil engineering, he received his master's degree in civil engineering from the University of Illinois and has completed further postgraduate studies at the University of Colorado and the Georgia Institute of Technology. He is a registered Professional Engineer in Colorado and Georgia.*

ANG firemen received 15 days of classroom and field training at Ramey AFB which included helicopter training.

Quality Work

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RAF Station, England; and provided engineering expertise to USAF and AFCS in support of EPA liaison and communication scheme construction in the Far East and Europe, respectively. These activities are additive, not a part of the annual training required by reserve personnel. They involve individuals volunteering their time to demonstrate they are ready and able to support their active duty counterparts when their skills are needed.

Like the active duty counterpart, AFRES Prime BEEF has adopted the "Can Do/Will Do" credo. More important, actions by personnel demonstrate their desire to fulfill their newly established mission, and they do the job when the chips are down. As one host BCE so ably put it, "They bounce off the aircraft on the run, with a tool box in one hand and a suitcase in the other. The first thing they drop is the suitcase." In a number of instances, they have left a chagrined host base briefing team waiting to fill them in on what had to be done, only to have the briefers find them already at the job sites, pouring concrete and pounding nails. Quality workmanship and productivity have become their hallmark. They recognize they are a supplemental force, and strive to establish a creditable reputation so that they can provide a realistic adjunct to the active force, if and when they are needed.

Better Qualified Craftsmen Result

There is no realistic means of identifying the dollar savings associated with the training aspects of this program. Instead, each deployment results in a better qualified craftsman, more closely aligned to the needs of the Air Force and better skilled to assume the Prime BEEFers' objectives of mobility, survivability, rapid response and bare base expertise. The by-product of their training, improved facility posture Air Force-wide, is also difficult to establish as a definitive figure. But here are some facts that can be used by the host base engineer and his planners as guidelines for programming their work and recording this "donated labor":

- Each flight has 81 enlisted personnel authorized, with an average civilian experience of 10 years per man, or the equivalent of 810 man years per flight.
- Each flight has four fully qualified engineering officers who make their living in civilian life as sophisticated design production or management specialists. The average experience factor here is about 15 years, or the equal of 60 man years total per flight.
- Each flight averages about 12 days at the host base location, with only one of those days off during the tour.
- The average workday of each team is about 13 hours.

Quick caluculations show that each team has available 11,600 hours of work during its tour. Recognizing less than 100 percent efficiency, it is estimated that roughly one-third of that time is unproductive at the deployed location. That is probably excessive because there are no domestic pressures and a team can concentrate on getting on with tasks at hand. The resulting 7,700 available manhours represent hard dollar savings to the Air Force. Using the shop rate average of $6 per hour, this means a savings of approximately $46,000 per team, with a total force annual savings potential of some $1.5 million. Admittedly, these savings are not readily recognized since the tasks accomplished often fall into the areas identified as non-mission limiting. They go into the low priority two and three projects that plague the BCE, with particular emphasis on health, welfare and recreational benefits to the active force. This too has become a trademark of AFRES Prime BEEF—an assist to the active force enlisted ranks—troops helping troops. AFRES people relate to their active duty counterparts and are responsive to their needs for upgrading people-oriented facilities.

AFRES Prime BEEF personnel load equipment and supplies aboard a C-130 prior to deployment to a base.

AFRES Prime BEEF has matured and is now recognized by every major command of the Air Force as a reliable supplement to active force "Base Engineer Emergency Forces" during both contingency operations and as a helping hand during periods of austerity to maintain the facility posture in at least a status quo. Much concern has been expressed by Air Force engineering managers regarding inadequate funds and personnel to support the upkeep of existing physical plant assets, much less replacement of antiquated facilities. This, coupled with the ever decreasing manpower, dictates that some alternate methods be provided. AFRES Prime BEEF can help fill some of this void.

Further, this approach tends to contradict the adage that an asset, once used, is dissipated. Instead, the more we use this resource, the greater becomes its potential for future use. In the AFRES, training is our objective. Today, hands-on training provides AFRES Prime BEEF forces the ultimate experience to assure their readiness when they are called.

CE

Professional Force

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average to excellent. NGB Civil Engineering has received testimonial letters from bases that have hosted ANG teams which compliment the teams on their performance in completing projects. On the part of the ANG teams, there have been many rewarding projects and some frustrations, particularly in regard to insufficient materials or equipment, but from the NGB down, the emphasis is on improvision if necessary to get the job done, but **get it done!**

Air Force Civil Engineers who request an ANG flight to accomplish a project should review the work in terms of available skills within the ANGUS Prime BEEF flight. The mission of the ANG is to **train,** and in the tight economy of today, this can be translated to **train by accomplishment of worthwhile projects.** When a team chief has a choice of projects, he will pick one that will benefit his flight the most, which strengthens both the ANG and the Air Force Civil Engineering programs.

Another suggestion to the Air Force Civil Engineer is, if the project does not include sufficient overall skill training, take a look around the base for skill work to which the Guardsmen can be shifted. It is highly important to the future of the ANG program (and the long-term interest of the Air Force) not to have plumbers working as carpenter's helpers, or power production men as laborers. In the past few years, two things have been paramount, enabling ANGUS Prime BEEF teams to retain good people in the ANG: **worthwhile deployments** and **utilizing Guardsmen in their assigned skills.**

Firemen can play an essential role in augmenting a host base's fire department, while obtaining needed training and skill-advancement under the tutelage of local professionals. If you have need for augmentee fire-fighters, it would be well to touch base with the NGB before firming up your plans, since some Prime BEEF deployments can include fire-fighters, if needed, or ANG can deploy as an element separately from its units.

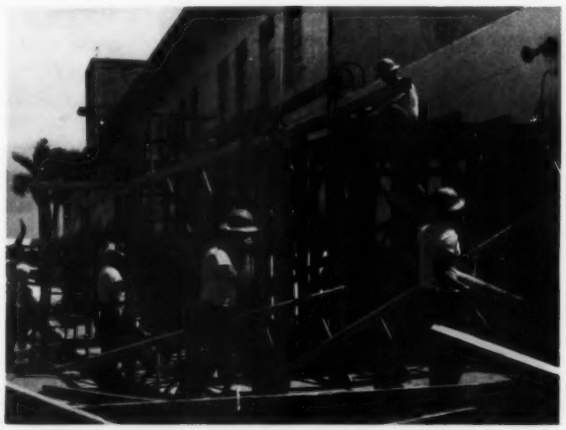
The ANG can provide the Air Force with many civil engineering man-hours yearly. In both the man-and-money pinch, this is no small addition to Air Force manpower. Just as important, Air Force regulars can provide needed assistance in developing and advancing ANG skill level competence, particularly in areas difficult to train at an ANG location, such as engineering entomology, liquid fuels system maintenance, water and waste, etc.

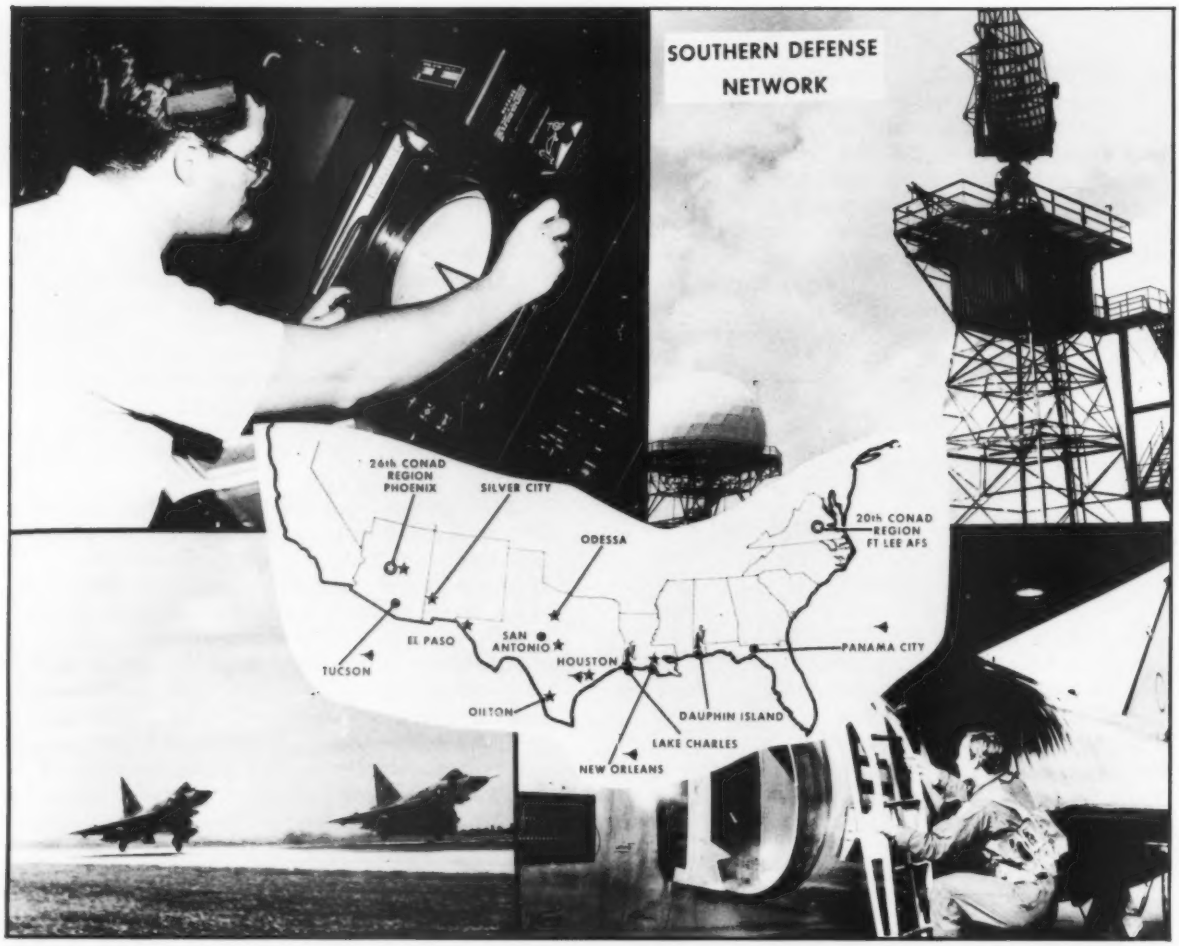
Transportation for deployment under present circumstances must be arranged by the requestor. ANG airlift is "tight" with little hope for relief in the immediate future. The transportation problem requires advance planning and coordination. Major commands willing to assist with airlift get first consideration when teams are assigned.

So, if you'd like to have some extra man-hours you can't squeeze out of your planning, think ANGUS Prime BEEF. And if you have an all-skill project or a set of several projects, submit your request. Then see what "Can Do" of the ANG **can do and will do!**

CE

New Hampshire 157CE flight personnel construct concrete canopy at entrance to passenger terminal at Ramey AFB.





A joint Federal Aviation Administration and Aerospace Defense Command program has been completed to bolster the air defense for the southern perimeter of the United States. Here's how engineers assisted in . . .

Closing the Gap in Air Defense

by George A. Loudis, PE

A news story released on 28 July 1972 stated in part: "A joint Aerospace Defense Command (ADC) and Federal Aviation Administration (FAA) program is currently underway to bolster the Air Defense for the southern perimeter of the United States." A CSAF message of 31 May 1972 reported that a Southern Air Defense radar network would be operational by 30 June 1973.

The air defense network to track and detect aircraft uses eight existing FAA Air Route Search Radar facilities with the addition of an FPS-6 Height Finder Radar at each site, and two separate ADC Search and Height Finder Radar facilities. The eight FAA radar installations are located near New Orleans, Louisiana; Oilton, Odessa, Ellington AFB, Lackland AFB, and El Paso, Texas; Phoenix, Arizona, and Silver City, New Mexico. The two ADC radar installations are located near Lake Charles, Louisiana, and Dauphin Island, Alabama.

Initial operational capability (IOC) dates were established to gradually phase the system into operation in the period from January to June 1973. Site selection, programming, requirements and funding actions by ADC were made during June and July 1972. Engineering site surveys and design were accomplished during August through December 1972.

Construction planning, scheduling and preparing support agreements for utilizing base resources of other commands were required to put the package together.

The major construction item was installation of the FPS-6 Height Finder Radar at the FAA sites. Civil engineering construction requirements at the various sites included radar tower footings, cable ducts and trenches, operation areas with limited administrative facilities, interior and exterior electrical distribution system, air conditioning, fencing, roads and related sitework. Construction costs for this program were set at $900,000.

Southern Communications Area (SCA) (AFCS) located at Oklahoma City, Oklahoma, was assigned the electronic equipment program. SCA's responsibilities included establishing civil engineering design requirements and criteria for the radar installation, furnishing all related radar and electronic equipment, furnishing and erecting the FPS-6 radar tower, and installation and checkout of the radar system. In a great effort, SCA gathered the required electronic equipment, scopes, cables, nuts and bolts, and old radar towers from all over the country and distributed them to the new locations. Once installed, the system worked, even though some of the equipment had been in storage for 10 years or more. The entire SCA operation is a tribute to the Air Force technicians schooled in radar installation and operation.

Engineering Surveys Made

The civil engineering surveys for the FAA-Air Force sites were made with representatives of FAA, SCA and ADC. Requirements were established as to **what** was going **where** with the emphasis on utilizing existing facilities. Height Finder Radars were located to provide the area coverage to detect unidentified aircraft without causing interference to the Search Radars. The three agencies involved agreed on a joint-use operation, even though ADC was encroaching on FAA property with SCA equipment manned by ADC personnel. The preliminary work was done, and within a matter of only a few months, the time had arrived to put the information on the board.

In the short period between September and December 1972, design was accomplished by ADC personnel. There were 85 original drawings for the entire project. In a program moving as rapidly as this, changes in requirements and criteria were ever present. Forty-three of these drawings were completed by one man. Once design was completed, the last hurdle to overcome was construction on the sites. However, there was one problem: not one site was to be supported by a base of the command. ADC had to rely on bases of other commands to complete procurement, construction management and inspection. It did furnish construction inspectors at three of the FAA-ADC sites, but there were still things like change orders, acceptance inspections, supply and budget support, etc., which had to be accomplished.

The support by Air Training Command (ATC) and Tactical Air Command (TAC) was outstanding. In addition to their own workloads, they took on the ADC projects. Keesler AFB (ATC) supported Slidell, Louisiana, and Dauphin Island, Alabama; Laredo AFB (ATC) supported Oilton, Texas; Lackland AFB (ATC) supported the Lackland facility; Webb AFB (ATC) supported Odessa, Texas; England AFB (ATC) supported Lake Charles, Louisiana; Holloman AFB (TAC) supported El Paso, Texas and Silver City, New Mexico sites; Luke AFB (TAC) supported the Phoenix, Arizona facility at Humboldt Mountain.

It is difficult to single out the many individuals who contributed to the success of the project. Cooperation and aggressiveness of the fine contracting officers in the Air Force procurement system was paramount to the ultimate successful completion of the program. Situations such as short advertising time, negotiated walk-through and immediate awards—all helped in meeting the initial operational dates.

With design complete, contracts awarded and construction underway, ADC watched the progress, conducted surveillance inspections and monitored the funds. On 30 June 1973, the ADC Directorate of Information issued the following news release:

GEORGE LOUDIS *is a Civil Engineer at Headquarters Aerospace Defense Command, Ent AFB, Colorado. A graduate of the University of Chicago with a bachelor's degree in civil engineering, he has been associated with Aerospace Defense Command since 1960. He is a registered Professional Engineer in Colorado.*

"SOUTHERN AIR DEFENSE NETWORK COMPLETE—A network of radars and interceptor aircraft for the defense of the southern United States became operational June 30. With the completion of the system, communications were established to link radars, interceptors and ground controlled intercept facilities capable of identifying and intercepting intruder aircraft along the entire southern U.S. border. The Southern Defense Network is composed of elements of the Aerospace Defense Command and the Continental Air Defense Command. Completion of the network closes a gap in the air defense ring which guards the air approaches to the entire North American Continent."

In evaluating the program since its completion, it can be said that there were neither unsurmountable technical difficulties nor any new design or construction concepts. There was one goal—**get the job done.** At the beginning, it appeared to be an impossible task, but it became a reality because of the aggressive and cooperative professionalism of all the agencies and personnel involved. CE

Personnel scrub grease and grime from an A-7-D aircraft with an alkaline cleaner solution at the Oklahoma AMA.

Primary mission and support functions within the Air Force produce varieties of liquid industrial wastes. Base Civil Engineering is responsible for the proper collection, treatment and disposal to preclude environmental pollution. What follows are the Air Force methods of . . .

Eliminating Industrial Liquid Wastes

by Robert H. Keggan, PE

Aircraft components undergo cleaning and depainting at this McClellan Air Materiel Area, California facility.

Virtually every Air Force installation generates liquid industrial wastes (IW). Both primary mission and support functions produce varieties of such wastes which require proper collection, treatment and disposal to preclude environmental pollution. The latter operations are Base Civil Engineering responsibilities; however, reduction or elimination of pollutants is everyone's job, especially those who produce the wastes.

Eliminating pollution involves two phases:

- Identification of the problem;
- Determining and applying a suitable solution.

Identification requires a careful survey of facilities and operations to find the source. Sampling and analysis of surface and ground water supplies are also necessary. Useful information and guidance on performing water pollution surveys are provided in **AFM 85-14, AFP 161-20,** and Chapter 6 of **AFM 88-11.** Surveys should be cooperative efforts of Civil Engineering and bio-environmental personnel. Assistance, more extensive surveys or special laboratory analyses can be obtained from one of the Air Force Environmental Health Laboratories. Requests for such support should be made through local medical service channels following procedures outlined in **AFR 161-17.**

Policy Contained in AFR 19-1

Policy on environmental protection is contained in **AFR 19-1.** The preferred method of pollution abatement is, of course, elimination of the pollutant. This may be possible by changing the operation or materials used. Reduction of pollutants should be attempted where elimination is not feasible, or the problem minimized by moving the operation to a location where adequate collection features already exist. When pollutants cannot be eliminated by one of these methods, then collection, treatment and disposal are required.

SOURCES OF INDUSTRIAL WASTES

Aircraft operation and maintenance activities create the greatest volumes of liquid wastes. In addition, these activities produce some of the most concentrated and difficult to treat wastes. This is especially true of Air Force Logistics Command's Air Materiel Area (AMA) installations where depot level maintenance and overhaul, plus other industrialized workload, are accomplished. However, support functions such as vehicle maintenance, civil engineering, reproduction, photographic laboratories, personnel service shops, and research and development also produce liquid industrial type wastes. **Figure 1** lists many of the IW sources common to Air Force bases.

TYPICAL WASTES

Air Force industrial waste pollutants of greatest significance can be grouped into general classifications. **Figure 2** lists common specific examples of pollutants under the general classification of petroleum products, solvents, metals and miscellaneous. The pollutants are related to various sources in **Figure 1.** Water quality standards are continually becoming more restrictive in the amounts of these pollutants permitted in discharges to natural waterways or allowed to infiltrate sub-surface water supplies.

COLLECTION CONCEPTS

Collection and transport of liquid industrial wastes are accomplished both by batch hauling and by sewerage systems. The choice is dictated by waste characteristics as well as the availability of handling equipment or installed collection systems.

Small quantities, concentrated wastes, those requiring special treatment, and wastes from areas not provided with suitable sewers are collected in drums. tanks or underground sumps for trucking to the treatment and disposal sites. Drums and other small containers can be moved by pick-up, stake or dump trucks. Special tank carts or tank trucks are used for larger quantities or where collection is by underground holding tanks. A method easily adapted at most Air Force installations is the use of rear hoist refuse vehicles (Dempster Dumpster type) with special tank type containers, which are standard manufactured items.

Sewerage Systems Used

Sewerage systems used for collection of industrial waste waters include the regular sanitary sewers and, in some cases, special industrial waste sewers. Separate industrial waste lines are normally provided only where large volumes of IW are generated, such as at AMA installations, and usually only when special IW treatment facilities are available.

Discharge of industrial wastewaters to sanitary sewers is possible in many cases. However, four major considerations must be evaluated in each instance. These involve the possible effects of the IW on the collection system and on the treatment processes. Therefore, the following determinations must be made:

1. **Will the IW cause deterioration of or stoppages in the collection system?** Strong acid solutions might cause deterioration of some pipe and equipment ma-

Cont'd next page

Figure 1: Industrial Waste Sources Common to Bases.

FUNCTIONS	POLLUTANTS
Ramp Operations	Fuels; Oils & Greases; Hydraulic Fluids; De-Icing Glycols
Pavement De-Icing	Urea (NH_3 & Nitrates); Chlorides.
Wash Racks Aircraft A.G.E. Vehicle	Surfactants. Solvents. Oils & Greases. Metals; Suspended Solids; Phenols.
Corrosion Control Paint Stripping Painting	Solvents. Methylene Chloride. Hexavalent Chromium; Phenols; Paint Skins & Pigments; Metals.
Maintenance Shops Aircraft A.G.E. Vehicle	Oils & Greases. Solvents. Carbon Removers. Surfactants; Hydraulic Fluid; Solids; Glycol.
Non-Destructive Testing	Dyes; Alcohols; Developers, Surfactants.
Battery Shops	Lead; Sulfates; Acids.
Plating Operations	Acids; Caustics; Cyanides; Metals; Alkaline Cleaners.
Cooling Towers	Phosphates; Heavy Metals; Algicides; Total Solids.
Heating Plants	Tannin; Phosphates; Chlorides; Carbon & Ash.
Sewage Plants	Digester Supernatant; Sludge Drying Bed Underflow.
Water Treatment Softening Filtration Demineralization	Chlorides. Lime Sludge. Acids. Caustics.
Photo Labs	Acids; Cyanides; Dyes; Silver; Other Chemicals.
Petroleum Storage & Heating	Oils; Fuels.
Laundry Facilities	Surfactants; Soaps; Suspended Solids; Oils & Greases.
Service Stations & Hobby Shops	Oils & Greases; Fuels; Surfactants; Solids.

Liquid Wastes

cont'd

terials, while heavy grease or high solids loadings could cause stoppages.

2. **Will the IW create fire or explosion hazards to the collection system?** Wastes containing inflammable materials or collected from an area or facility where a liquid fuel spill might occur cannot be discharged directly to sanitary sewers. Sewer explosions do occur and are dangerous to personnel, property and facilities.

3. **Will the IW adversely affect the treatment processes?** Many industrial pollutants are toxic to the biological secondary treatment processes commonly used in sanitary sewage treatment plants. These can include cyanides, heavy metals such as chromium and cadmium, phenols, biocides, etc.

4. **Will the sanitary sewage treatment facilities provide adequate pollutant removals to meet established water quality discharge limits?** Pollutants such as dissolved heavy metals, surfactants (detergent) and phenols are difficult to treat, and excessive quantities may pass through treatment plants. Treatment efficiencies may be adequate below certain pollutant concentrations, yet inadequate at higher concentrations.

Measures Can Be Taken

Fortunately, an initial answer of "yes" to one or more of the above questions does not necessarily preclude collection of the wastes in the sanitary sewers. Protective or pretreatment measures can be taken to eliminate or minimize the adverse effects. Acid or caustic wastes can be neutralized, and gravity separators will remove grease and solids. Oil separators of adequate size and storage capacity can be installed to prevent gasoline, JP-4, and similar inflammables from entering the sanitary sewers.

The toxic effects of wastes to biological sewage treatment processes can be either the kill-off of the beneficial microorganisms or a severe reduction in their activity and growth rate. Such effects would seriously decrease the efficiency of the plant and reduce its effluent quality. However, the extent and seriousness of these bactericidal effects depend on the concentration of the pollutants, not merely on their presence. The removal efficiencies of treatment processes also vary with the pollutant concentrations. Pretreatment or controlled discharge are other concepts which may be used to permit IW discharge to sanitary sewers. A chemical treatment process such as cyanide destruction, heavy metal precipitation, neutralization or chemical oxidation may be necessary to remove a troublesome pollutant or to reduce it below a tolerable level for safe treatment in a sanitary sewage plant.

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Many industrial operations are often limited to one or two shifts per day and possibly only five days per week. Further, a given operation generating an industrial waste may be intermittent or performed only occasionally. Toxicity or pollutant loading problems can in many cases be overcome by collection of the wastes in a sump or holding tank with controlled discharge to the sanitary sewer. This method prevents the pollutants from arriving at the treatment plant in concentrated slugs by assuring equalized dilution of the IW in the sanitary sewage flow.

Pollutant loadings into a treatment process are calculated using the volume and pollutant concentrations of the IW together with the volume or dilution ratio of the sanitary sewage. Allowable concentrations to preclude toxic effects and which will result in suitable plant effluent quality vary for different pollutants. Information on limiting concentrations can be found in technical literature on sanitary engineering, industrial waste treatment and pollution abatement. **AFP 161-20** contains some guidelines on limiting concentrations of cyanide and heavy metals. Special laboratory studies can be performed to determine the

Cleaning workers wash down a C-141 at the wash rack prior to repair/delivery to using activity at Robins AMA.

limiting pollutant concentrations or IW/sewage dilution ratios required for biodegradation of a given waste. Warburg Oxygen Uptake Studies and Batch Activated Sludge Treatment Studies are two such testing procedures used by the Air Force Environmental Health Laboratories (EHL). Reports have been published by the Kelly EHL on several common Air Force wastes (wash rack wastes, aircraft paint stripping wastes, color photo processing wastes, etc.).

TREATMENT AND DISPOSAL

Treatment and disposal concepts for industrial wastes also vary. Combined treatment with sanitary sewage is the most economical and preferred method. Combined treatment after pre-treatment, as discussed previously, is also practiced. Wastes which cannot be handled by either of these methods must be batch treated, disposed of by contractural arrangements, treated in a separate IW treatment plant, or placed in an approved disposal site or deep well.

Treatment processes utilized for industrial wastes include those commonly used with sanitary sewage plus several others. In the first category are screening, sedimentation, biological oxidation, sludge handling, and possibly some tertiary processes. Special concepts with IW applications are chemical treatment, neutralization, precipitation, air flotation, pyrolysis (combustion), ion-exchange, activated carbon absorption, membrane separation and stripping. Regeneration for re-use may be an alternate to treatment and disposal. Lagooning, direct burial, spray irrigation, and land disposal are practiced under certain conditions. Sale of certain liquid wastes is accomplished through Redistribution and Marketing. Waste oil and other petroleum products are often sold.

Oils, greases, phenols, solvents, surfactants, and other organic pollutants in tolerable concentrations can be removed by biological oxidation processes. Cyanide ion destruction is usually by a chemical reaction such as alkaline-chlorination. Cyanide wastes must be continuously maintained at a pH above 8.5 to preclude formation of cyanogen chloride, a toxic gas. Heavy metal compounds (chromium, nickel, zinc, lead, etc.) can be precipitated as their hydroxides by raising the pH of the waste by adding lime, caustic soda or other alkaline reagents. Removal of hexavalent chromium, however, requires use of a reducing agent such as SO_2 or Fe SO_4 to change the highly soluble chromate to the trivalent or chromic state prior to precipitation.

Figure 2: Common Examples of Pollutants.

Petroleum Products	Oils; Greases; Fuels; Hydraulic Fluids.
Metals	Chromium; Zinc; Lead; Silver; Mercury; Nickel; Cadmium; Copper; Iron; Aluminum; Magnesium.
Solvents	Distillates; Alcohol; Acetone; Ketones. Trichloroethylene; Glycols; Ethers; Chlorinated Hydrocarbons.
Miscellaneous	Cyanide; Phenols; Surfactants; Detergents; Soaps; Chlorides; Phosphates; Sulfates; Acids; Caustics; Tannin; Dyes; Suspended Solids; Organics; Biocides.

NO SINGLE, CLEAR CUT OR EASY ANSWERS

The proper handling of liquid industrial wastes can become a complex and highly technical operation. Many variables enter into considerations of collection, treatment and disposal methods. More than one concept may be applicable to a given waste, requiring other aspects such as safety and economics to be considered. Therefore, much study, consultation and research is needed in designing for or outlining industrial waste handling practices. But as environmental protection standards become more stringent and enforcement more rigid, Air Force Civil Engineering must shoulder this workload with a "Can Do, Will Do" attitude. CE

This special liquid waste container is capable of being used with a rear hoist refuse vehicle, common to most AFBs.

Aircraft tires may obliterate the paint markings on runways and add to the accumulation of rubber deposits because of touchdowns at high speeds. Engineers at Webb AFB, Texas, came up with a new application to an old technique for providing . . .

Better Visual Runway Identification

by James M. Tidwell, PE, Civil Engineer, 78 Flying Training Wing, Webb AFB, Texas

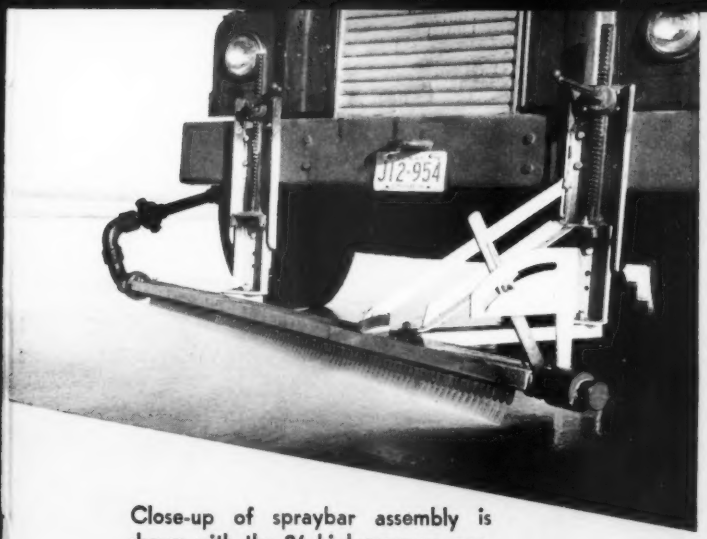
Runway markings at Air Force bases are normally painted on an annual basis. They provide visual runway identification to the pilot as well as navigational assistance for take-off and landing operations. Over a period of years, markings become obliterated by aircraft tire markings, spalling due to build-up and normal paint deterioration. It then becomes necessary to remove the paint to the original pavement surface prior to repainting.

In the past, paint removal had been accomplished by sandblasting, hand scraping, chemicals and scraping with a maintainer. The chemicals used in these methods of removal were found to be hazardous to personnel, caused corrosive problems and were ecologically undesirable. Also, excessive damage to the pavement surface resulted from use of the maintainer, and sandblasting and hand scraping proved to be less than satisfactory.

In the paragraphs that follow, a new application of an old technique will be explained. Specifically, water pressure was employed by engineers at Webb AFB, Texas, to remove 100,000 square feet of paint from the runway pavements. In addition, rubber deposits were also removed from the runways on an experimental basis.

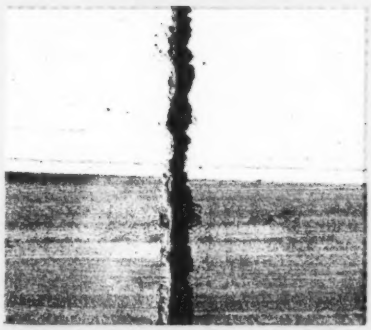
The water jet technique used at Webb AFB, Texas was a first for the Air Force since this method of removal had never been employed previously. Its most significant advantages are clean removal of paint and rubber, its economy and rapidity in removal. This last advantage is most desirable since aircraft traffic density restricts the time available for performance of pavement maintenance.

Hydraulic jetting has been used for many years as a method of cleaning surfaces with varying degrees of success. Originally, the operation was low-pressure, using water main pressures or, in some instances, booster pumps in the 200 to 300 psi range to clean grime from streets. It became obvious



Close-up of spraybar assembly is shown with the 96 high-pressure nozzles installed on one-inch centers.

High - pressure pumping equipment moves down runway, removing paint deposits from airfield pavements.



Upper part of photo reveals paint and rubber cleanly removed. Note that joint seal has not been damaged.

that higher pressures removed deleterious materials more rapidly, including the tighter clinging particles. Experimentation with higher and higher pressures, particularly in those industries requiring removal of foreign deposits from heat exchangers, piping and pressure vessels, has led to the present state of the art. Development of high-horsepower hydraulic pumps capable of pressures in the 15,000 to 20,000 psi range further expanded the use of hydraulic jetting in the oil industry for well perforation and fracturing.

Runway paint markings were removed at Webb AFB in July 1972 by Halliburton Company, a petroleum industry services company. The company used its standard, trailer - mounted hydraulic, well-fracturing unit which consists of large hydraulic pumps driven by two 750 horsepower diesel engines. The pumps are connected by piping to a spraybar mounted on the tractor's front bumper for delivery of water at high pressures through jet nozzles to the pavement surface. The nozzles have a 0.078 inch diameter orifice and are installed on one inch centers. The spraybar has adjustment capability for angle of impingement and nozzle standoff. A maximum of 96 nozzles can be installed in the spraybar. Water is supplied to the pumping unit through a flexible hose from a water tanker as it travels parallel to the unit.

The scope of work for the Webb AFB project consisted of removing 100,000 square feet of paint markings from two runways. The runways are asphalt except for 1,000 feet of concrete at each end. Approximately 95,000 square feet of the paint was removed from the concrete in aircraft touchdown areas. Paint was removed very successfully in the concrete areas without damage to the pavement. On asphalt pavements which showed signs of surface deterioration, it was necessary to exercise caution and adjust the nozzle pressures accordingly to preclude pavement damage. The condition existed only in non-traffic areas along the edge of the runways.

For paint removal, the effective spraybar width was two feet with the nozzles on one-inch centers. Hydraulic pump pressures were in the 7,000 to 7,500 psi range and dwell time was one foot per second. Rate of paint removal for the project at the completion of the job was approximately 13,000 square feet per hour. Thickness of the paint removed varied from 1/16 inch to 3/16 inch with the thickest paint being the easiest to remove. Clean-up of an estimated 8 to 10 cubic yards of loosened paint particles was accomplished by Air Force vacuum sweepers.

Prior to removing paint or rubber, the condition of sealing material in joints and random cracks was carefully checked. If the material is not lively or bonded, considerable loss of sealing material can occur from the water pressure. In that condition, the material obviously needs replacing. At Webb AFB the sealing material was in excellent shape, very lively and maintaining good bond with no damage occurring from the water pressure.

Unit cost for removal of 100,000 square feet of paint markings at the base was $0.06 per square foot for a total contract cost of $6,000.

Rubber deposits result from touchdown of high-speed aircraft and accumulate at a rate proportional to the number of landings. When one-third to one-half of the first 2,500 feet of a runway is covered with rubber deposits and is wet, the associated slipperiness creates a serious accident potential. Pavement surface-friction evaluations in recent years using specialized equipment have demonstrated that rubber-covered areas on a

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Runway

cont'd

runway are almost twice as slick when wet as the clean portion of the runway.

At the request of the Air Force in late 1972, the Halliburton Company provided its high-pressure equipment used in the paint removal project for removal of rubber deposits on an experimental basis at Webb AFB. The orifice diameter of the nozzle used was 0.040 inch, or approximately one-half the diameter of the orifice for the paint removal nozzles. Numerous combinations of variables were tried to determine the most effective removal rate and degree of cleanliness for the rubber deposits. Variables included dwell time from one to three feet per second, nozzle stand-off 1/2 to 1-1/2 inches, hydraulic pressure 5,500 to 7,500 psi, effective spraybar width six to eight feet, and surface impingement angle 37 to 52 degrees. Results of the experiments indicated the desired degree of cleanliness for rubber removal could be obtained using an eight foot spraybar, 1-1/2 inch nozzle stand-off, 7,000 psi pump pressure, and a dwell time of one foot per second. On the basis of the experiments, rubber removal rates in the 40,000 to 50,000 square foot per hour range should be reasonable to achieve. Cost for rubber removal projects in the fall of 1972 ranged from $0.035 to $0.0475 per square foot.

In the future, it appears most Air Force bases will be removing 200 to 300,000 square feet of rubber deposits each two to three years. At a removal rate in excess of 40,000 square feet per hour, it will be possible to remove 300,000 square feet of rubber with minimum interruption to the normal flying schedule.

Although this article discusses rubber/paint removal employing truck mounted equipment, it should be noted that recent rubber removal projects have been accomplished manually using hand-held lances.

Other potential uses of the high pressure water jet technique include:

- Scoring/grooving asphalt pavements.
- Roughing/cleaning the surface of concrete to provide bond for overlays.
- Removing build-up of paint on centerline of highways and traffic island curbs.
- Roughing pavement surfaces to reduce slipperiness.

Development of high-horsepower pumps for use with high-pressure nozzles has provided an ecological, economical and technically desirable method for removal of deleterious deposits from pavement surfaces. CE

Here's How George (AFB) Did It !

A recent rubber removal project on one end of the primary, concrete runway at George AFB, California was completed by use of high pressure water. From start to finish, the 16 hours expended to complete the job resulted in the effective removal of 95 percent of the rubber.

Three water blaster pumps mounted on a truck fed the water into a bar with 20 spray nozzles. The nozzles, with a 0.15 inch orifice, were mounted on 1-1/2 inch centers. Using 45 gallons of water per minute, the most effective spray pressure was found to be 9,000 psi. Pressure below 9,000 would not cut the rubber and pressure above 9,000 psi damaged the pavement and joint seal. Pressure of 10,000 psi wore the jet nozzles and necessitated replacement. The most effective speed for the vehicle was 200 feet per minute. Less speed or stopping caused damage to joint seal and concrete. The angle of spray was 15 degrees from vertical to the rear. Three passes were made on the center section of the runway to obtain the 95 percent removal.

Water blaster pumps, mounted on front of vehicle, feed water into the bar which has twenty nozzles.

Prior to the start of the project, the braking action on wet pavement was less than 10 on a standard vehicle mounted brake meter. Braking action on wet pavement, where rubber was never deposited, was 16. Braking action on wet pavement in the center of the runway after rubber removal was 15. Neither joint seal, paint stripes nor concrete was damaged by the water blast. All rubber was disintegrated to the extent that no cleanup, other than washdown, was required.

The cost of rubber removal was $4,130 for 9,200 square yards, or approximately 5 cents per square foot for water blast rubber removal. This compares to approximately 6 to 7 cents per square foot for acid removal with the danger of pollution.

Worth Noting

New "Tele-Teach" System Offers Education Features for BCE Staffs

Instructor conducts "Tele-Teach" class from his Wright-Patterson AFB office to any base within the CONUS.

Ever feel the need to get a member of the Civil Engineering School faculty to come to your base for an hour to talk over a current base problem with you and your people? In the past, it has been impossible to meet this need economically. However, the Civil Engineering School at Wright-Patterson AFB, Ohio has been experimenting with teaching by telephone (Tele-Teach) and it now seems that Tele-Teach may be an economical way to provide short blocks of instruction to small groups of civil engineers at their bases.

All that is involved is a "speaker phone" at the base. The speaker phone can be ordered through base channels; in a number of cases, many are already installed in Base Civil Engineer (BCE) offices or conference rooms.

The Civil Engineering School has prepared 10 subjects (specially chosen for groups who work together). From these subjects the BCE can select topics useful to his group. The 10 topics are: BEAMS/An Overview; Computer Products as Management Tools; Using Automated Total Programming; Base Level Inquiry System (BLIS); BLIS for Branch Chiefs; BEAMS/The Executive Management Summary; Management by Objectives; Using the Recurring Maintenance Program (RMP); Conducting the Management Review Committee (MRC) Meeting; Using the Visible In-Service Work Plan. When the school receives a request, it mails a "Tele-Teach" Kit to the base. Kits vary by subject, but can contain:

- Instruction to the Base Project Officer.
- Advance reading assignments for participants.
- Slides, Vugraphs or handout materials.
- Tele-Teach critique forms.

The class is assembled around the speaker phone. The phone connection is completed between the School and the base—and the teaching begins. Slides are projected whenever the instructor "clicks" or signals for a change. Questions can be asked by any student at any time. He merely "clicks" to indicate to the teacher that he has a question.

The first class was held at Lockbourne AFB, Ohio, for 10 participants. The teacher was at Wright-Patterson AFB. There were no problems. The cost was $12.50 for a regular long distance line (to avoid possible interruption). In the future, phone line costs may be reduced through arranging for WATS transmission of the lesson.

An advantage was that both the participants and the teacher were back at work right after the lesson. Little productive time was lost and, of course, there were no TDY costs. The School plans to experiment with the 10 selected subjects for another 12 to 18 months. At that time they will recommend dropping, modifying or expanding their Tele-Teach efforts, depending on their experience during the experiment period.

Robins Civil Engineering Division Presented Professional Award

The Civil Engineering Division at Robins AFB received the State Governmental Professional Development Award from the Georgia Society of Professional Engineers. The award to the WRAMA organization for the professional development of its engineering staff was presented at the Georgia Society of Professional Engineers annual meeting in Nassau, the Bahamas in June. Roy Ditterline, Deputy Base Civil Engineer, accepted the plaque symbolizing the award on behalf of the Base Civil Engineer, Col Ervin F. Bork.

The Civil Engineering organization was praised for its outstanding record in the development and application of forward looking engineering employment practices and its high professional standards. During the time period upon which the award was based, the Civil Engineering Division was headed by Col Winston H. Clisham, now retired from the Air Force.

Maj Gen Robert E. Hails, WRAMA Commander, stated that the Division, as part of the overall Air Force Civil Engineering organization, encourages professional development of its engineering employees, effectively utilizes this development, and is continuously striving to improve its policies in relation to professional development and utilization.

When Called, They Are Ready!

With the Department of Defense announcement that the reserve and national guard forces would constitute an integral response element of future US military contingencies, the Air Force Reserve and Air National Guard missions have taken on a more demanding role. On pages 14 and 15 inside, you will learn how their civil engineering units constantly train to assure their readiness when they are called.

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